THURSDAY, JULY 4, 1907.

THE CONSTRUCTION OF DYNAMOS.

The Construction of Dynamos (Alternating and Direct Current). By Tyson Sewell. Pp. xi+316. (London: Crosby Lockwood and Son, 1907.) Price 7*s.* 6*d.* net.

SO many books have already been written on the subject of the dynamo that any new publication can only be justified on one of two grounds. Either it must contain new matter of practical importance not hitherto treated in such a way as to be useful to the designer, or it must be in comparison with existing books an improvement in the way of treating old and well-known matter, so that the student and the practical engineer may have less difficulty in grasping the subject than they often have with the existing books.

A perusal of Mr. Sewell's book will leave the reader with the impression that the designer of dynamos will learn nothing from it, and that the student may with equal advantage read any of the previous publications treating of the dynamo in a popular style. The book is in this respect no better and no worse than dozens of others. As regards its use for the design of dynamos, the author himself deprecates it, for he says in the preface:—

> "The examples of design are introduced by way of illustration only. The actual designing of dynamos is the work of comparatively few men, most manufacturers having standardised particular lines which, with slight modifications, meet most requirements; and in view of the labours of the Engineering Standards Committee, further developments in the direction of uniform practice may be expected."

The idea underlying this sentence seems to be that as only few men have to design dynamos, and as the Engineering Standards Committee looks after these things, it is not necessary to treat of design in books. Yet in the first sentence of the preface the author says that his work is an attempt to treat of theory, design, and construction, and several chapters are devoted to working out the details of design.

The general arrangement of the book follows well-known lines. We get first the fundamental principles of direct currents, Ohm's law, its application to the "Silvertown Set" and Evershed's "Megger," though without description of the internal arrangement and only an outside view of the box. Then come a few pages on the magnetic field and on testing iron, but the treatment is incomplete, and in one case also misleading. This is the description of the magnetometric method, where the author fails to point out that it is only applicable to thin and long wires, and not to a turned iron rod, as he says; and that the effect of the solenoid must be eliminated by a special coil. In the next chapter we get all the well-known illustration (but on a prodigiously large scale) to show lines of force, and how by cutting them an E.M.F. is produced, and the formula for the E.M.F. of a two-pole dynamo. It would have been well if the author had also given the formula for a multipole machine in this place. The chapter following deals with the fundamental principles of the alternating current, and then we get to the alternating field. Here the author introduces the hysteresis loop, and mentions that its area is a measure of the work lost per cycle, but gives no proof. The figures he gives for the hysteresis coefficient of 0·002 to 0·008 are certainly much too large, and he is also in error when he says that in dynamo work the loss due to eddy currents is very small. It is well known that the losses in iron actually occurring in the dynamo are considerably in excess of the theoretically calculated losses, and that the increase is in a large measure due to eddy currents at the burred edges of the plates. When dealing with capacity the author gives a neat hydraulic analogy to show why the charging current is a quarter phase in advance of the E.M.F.

In the chapters on construction and theory of bipolar dynamos we find the usual illustrations, but all on a large scale, so that a good deal of space is uselessly occupied and the text correspondingly restricted. Although in the illustrations the author follows well-known lines, this cannot be said as regards his way of designing. Here we find some novelty, but hardly improvement on the usual practice. Thus, in giving the design of a 400 kw. 550 v. machine, he starts with the rule that 100 kw. is a fair average allowance per pair of poles, and finds thus that eight poles is the right type. Then he calculates the number of commutator bars on the basis of 5 v. per bar, and by assuming a certain thickness he arrives at the diameter, and again by assuming a certain circumferential speed he obtains the number of revolutions per minute. This freedom in the selection of speed may be convenient, but it is certainly not the condition which prevails in practice. As a rule the speed is given, and one has to design the dynamo to suit it. Having thus found the speed, the author proceeds to find length and diameter of armature by simply applying the so-called "output formula," but as he does it without critical investigation he gets rather unusual dimensions, namely, 93 inches diameter by 15½ inches long, whereas a little common-sense reasoning untrammelled by adherence to formula would have shown him that 80 inches by 20 inches would make a far better and cheaper machine. The number of conductors is found from a formula of circumferential current density, and so the designing goes on simply by applying formulæ without criticism, not a method to be recommended either to students or to "engineers who have occasion to deal with technical matters," as the author says in the preface.

Another claim made in the preface is only partially justified. The author says that "the available space is almost exclusively devoted to machines representing present standard practice." There are a few illustrations of the fly-wheel type of alternator, and also a turbo-alternator, and in so far standard practice is considered, but the "mono-coil-claw" type, Fig. 200, the inductor machine, Fig. 201, and the ironless machines of Mordey, Ferranti, and Crompton, are certainly not present standard practice, whilst the details of armature housing shown in Figs. 192 to 197 may

© 1907 Nature Publishing Group

be modern, but are certainly not good practice. The author's explanation why field magnets are laminated is novel, and, moreover, so peculiar that it merits verbal quotation. He says:—

> "The field cores are often laminated throughout to prevent eddy currents due to any swinging of the field caused by armature reaction, and this often leads to special methods of support."

Had he said that magnets must be laminated if the stator slots are wide and open, he would have been right, but the explanation he gives is quite beside the mark. Equally misleading is his indiscriminate recommendation of damping coils as a cure for hunting. As he mentions these coils just after saying that hunting is especially the fault of gas-engine driven machines, the reader is led to conclude that the damping coils would be especially useful in such cases, whereas every expert knows that damping coils are absolutely harmful if applied to an alternator driven by a gas engine.

Gisbert Kapp.

STOKES'S SCIENTIFIC CAREER AND INFLUENCE.

Memoir and Scientific Correspondence of the late Sir George Gabriel Stokes, Bart., Past Pres.R.S. Selected and arranged by Prof. Joseph Larmor, Sec.R.S. Vol. i., pp. iv+475; vol. ii., pp. vi+507. (Cambridge: The University Press, 1907.) Price 24s. net, two volumes.

IT is well known that the record of Stokes's work, splendid as it is, which is contained in the five volumes of his collected papers is far from being a complete representation of the services which during a long life he rendered to science. From his first official connection with the Royal Society in 1854 the tide of production began somewhat to slacken, and after 1868, it may almost be said, no sustained piece of work of first-rate magnitude appeared under his name, although shorter papers, often of great value, and all showing the impress of the master-hand, were given out from time to time. His energies did not relax, and his powers never showed any sign of decay, but they were diverted into somewhat different channels. Partly owing to the rigorous sense in which he construed the duties of his various official positions, and partly in consequence of his own inexhaustible good nature, he was constantly occupied in examining, advising upon, and assisting in the work of others.

This gradual change in the manner of his work has been often wondered at, and sometimes deplored, but it came about quite consistently. There is a certain type of professional *savant* to whom systematic production, or at all events publication, with due form and circumstance, is as the breath of his nostrils; it must be maintained at all hazards. With this type Stokes had never any affinity. He took to mathematical physics, in the first instance, because his interests and his powers lay that way, and he published the results of his investigations, when they seemed valuable enough, as a matter of course; but when other duties came which had, as he thought, a more immediate claim, he turned to them without a moment's regret at the diminished opportunities of personal achievement which they involved.

For a complete memorial it was therefore essential that some presentation should be made of this important phase of his work. As Prof. Larmor explains, in the preface to the two volumes now before us, the material in the shape of letters is abundant; but it is naturally very varied in character, and often fragmentary, and much of it was from one cause or another difficult to turn to account. The labour of sifting and arranging the correspondence must have been enormous, and appears to have been aggravated by the circumstance of fresh letters continually coming to hand during the printing.

The material finally selected has been dealt with as follows. In "Section II." we have an outline of Stokes's general scientific career, illustrated by a chronological series of letters, which touch upon the various topics which at different stages attracted his attention. "Section III. A" contains "special scientific correspondence" with his father-in-law, Dr. R. Robinson, Prof. Cayley, and Sir J. Norman Lockyer. These letters contain matter which is, in different ways, of great interest; the letters to Dr. Robinson are specially valuable, as they preserve many interesting notes and explanations which would otherwise have been lost. The second volume continues "Section III.," and includes letters to and from Maxwell, Joule, Rayleigh, Reynolds, Froude, Airy, and others, nearly all bearing on scientific work of the first order actually in progress. It would be hopeless, and useless, to attempt an enumeration of the various points touched upon; but it is of interest to note with what zest Stokes turns, again and again, to the early objects of his scientific affections, such as the behaviour of sea-waves, the theory of the pendulum, and the varied problems of physical optics. The collection is most of all valuable in that we are allowed a glimpse into the workshop of the master. The most expert craftsman will find much to admire, whilst the novice may derive suggestion and encouragement, more perhaps than from the contemplation of the finished work, which is often apt to beget rather feelings of despair.

These volumes include also matter of a more formal biographical character. The introductory memoir by Mrs. Lawrence Humphry is a most attractive personal record, written with admirable tact and sincerity. To this are appended "appreciations" by intimate personal friends, Prof. Liveing, Sir Michael Foster, Sir William Huggins, and the Bishop of Bristol. Considerable space is devoted to the Jubilee celebration of 1899, and to the proceedings at the unveiling of the Westminster Abbey memorial. Both these occasions greatly impressed those who had the privilege of attending them, and the record will be highly valued.

All who are interested in Stokes and his work, in other words, the whole company of followers of physical science, will feel a deep debt of gratitude to Prof. Larmor for the devoted labour which he has expended on this memorial of his great predecessor. It appears, indeed, that our obligations to him are not yet exhausted. The reader of this notice will have remarked

© 1907 Nature Publishing Group